



# PROCEEDINGS OF THE THIRTEENTH ANNUAL ACQUISITION RESEARCH SYMPOSIUM

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## THURSDAY SESSIONS VOLUME II

### **Program Affordability Tradeoffs**

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## Panel 22. Improving Project Management of Complex Systems

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Thursday, May 5, 2016	
3:30 p.m. – 5:00 p.m.	<p><b>Chair: William Taylor, Col, USMC (Ret.),</b> Program Executive Officer Land Systems, Marine Corps</p> <p><b><i>A Conceptual Framework for Adaptive Project Management in the Department of Defense</i></b> Martin Brown, Jr., Project Manager, Program Executive Office for Enterprise Information Systems</p> <p><b><i>Program Affordability Tradeoffs</i></b> Brian Schmidt, Economic Analyst, The MITRE Corporation Josie Sterling, Economic/Business Analyst, The MITRE Corporation Patricia Salamone, Business and Investment Analyst, The MITRE Corporation Ginny Wydler, Principal Analyst, The MITRE Corporation</p> <p><b><i>Squaring the Project Management Circle: Updating the Cost, Schedule, and Performance Methodology</i></b> Charles Pickar, Senior Lecturer, NPS</p>



## Program Affordability Tradeoffs

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**Josie Sterling**—has been an Economic/Business Analyst at the MITRE Corporation since 1982, supporting cost analysis, analysis of alternatives, economic analysis, cost/benefit analysis, affordability engineering, trade-studies, and risk assessment and management for a variety of civilian and DoD sponsors. She holds a master's degree in mathematics from Tufts University. [sterling@mitre.org]

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**Ginny Wydler**—Principal Analyst at the MITRE Corporation, supports Defense sponsors with their acquisition strategies and source selections. She has over 25 years of experience in acquisition and is a former Navy Contracting Officer. She holds a master's degree in National Security Strategy, Industrial College of the Armed Forces; a master's degree in Acquisition and Contracting, Naval Postgraduate School; and a bachelor's degree in Business Administration, University of Maryland. She has published in the Defense Acquisition Research Journal and National Contract Management Association (NCMA) Journal. She is a Certified Professional Contracts Manager (CPCM) and a Fellow with NCMA. She was DAWIA Level III Contracting. [vwydler@mitre.org]

### Abstract

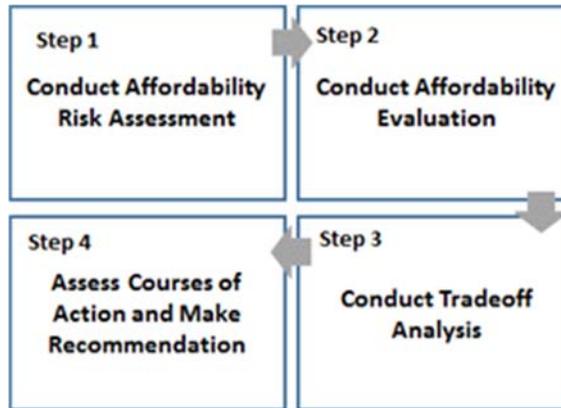
In today's fiscal environment, federal programs must be postured to conduct on-going tradeoff analyses to stay affordable as budgets are reduced and capabilities change or become more challenging to implement. This research focuses on recommended practices for conducting economic resource-constrained tradeoff analyses. The goal is to offer guidance to programs in making cost-effective affordability decisions that keep the program within its budget, or to find economic efficiencies if the program is currently affordable and within its budget.

### Background

Over the years, there have been major efforts within the federal government to reduce the cost of acquiring systems. The Government Accountability Office has shown repeated problems in meeting program milestones and keeping programs within cost and schedule requirements. Since 2010, the Department of Defense (DoD) has issued three versions of Better Buying Power for the DoD acquisition community, emphasizing the need for "affordability" (Carter, 2010; Kendall, 2012, 2015).

In response to these problems, the MITRE Corporation conducted an internal research project resulting in the Affordability Engineering Framework (AEF). The AEF, shown at a high-level in Figure 1, provides a structured framework with approaches and tools to address program affordability challenges over the life cycle (MITRE Corporation, 2012).





**Figure 1. AEF Framework**

Step 1 of the AEF is to identify and assess potential risks to program affordability, and to initiate actions to mitigate those risks. Step 2 is to examine the sufficiency of the program baseline and corresponding cost and schedule estimates, then to compare this cost estimate with the budget profile to evaluate life cycle affordability. Step 3 is to conduct a tradeoff analysis of courses of action for the purpose of making the program affordable or, if the program is currently affordable, to explore opportunities to improve program efficiencies. Finally, the objective of Step 4 is to help the decision-maker select the appropriate course(s) of action.

The research described in this summary is intended to facilitate Step 3 of the AEF. Specifically, the purpose of our research is to (part 1) gain an understanding of how government program offices currently conduct tradeoff analyses and (part 2) develop a guidance document and a software tool to help them with this process. This summary describes shortfalls in current practice that came to our attention during part 1 and recommendations for correcting these shortfalls. These recommendations will influence part 2, which is now under way.

### **Approach and Findings**

To better understand how program offices deal with affordability challenges and tradeoff analyses, we conducted interviews with MITRE staff supporting 19 government sponsors. The main topics of the interviews were to understand the following: what affordability tradeoff analyses programs typically conduct and what decisions are supported by the results of the analyses; what factors (inputs) are considered in conducting tradeoff analyses and how are they considered; and what resources (people, tools, time) are available to conduct these analyses. The information we gained from conducting these interviews will assist us in part 2 of our research (developing a guidance document and tool). Meanwhile, this summary paper deals with shortfalls in current practice that came to our attention in the course of the interviews. These shortfalls were in three areas: measuring benefit, combining metrics, and assessing risk in tradeoff analyses.

#### ***Measuring Benefit***

In many studies, the only measure of benefit was a technical performance measure, such as the speed of an aircraft. No attempt was made to connect this to a measure of effectiveness, which expresses how well the system carries out its operational mission. This approach leads to a “more is better” outlook. It does not provide insight into how much operational value is diminished when a lower cost alternative is selected and whether this is acceptable. In studies that used metrics that were not easy to express in scientific units,



such as “the ability to conduct close air support,” the system that was adopted for scoring was often not carefully constructed. For example, numerical scores were not given clear interpretations.

The authors recommend adherence to established decision analysis methods for rating value or utility. For further information on these methods, see Von Winterfeldt and Edwards’ (1986) *Decision Analysis and Behavioral Research*, Chapter 7.

### **Combining Metrics**

In studies that combined the scores of several metrics, weighted averages were almost always used. Although the weighted average is known to be the correct function to use when certain independence conditions hold (see, for example, Kirkwood, 1997, p. 243), there are cases in which such conditions do not hold, as is illustrated by a classic study of the Mexico City airport (Keeney & Raiffa, 1993, Chapter 8). The inappropriate choice of a function can lead to misleading assessments of overall benefit. For example, an alternative that improves the overall benefit score may be one that is improving metrics that are already at an acceptable level, while leaving other metrics below acceptable levels.

To ensure that tradeoffs are represented realistically, the authors recommend that analysts be aware of the existence of functions other than averages that can be used to combine metrics. Some examples are the Multiplicative Utility Function (Keeney & Raiffa, 1993), the exponential average (Schmidt, 2015), and the max-average (Lamar, 2009). We are continuing research to investigate methods for making these concepts more understandable and useable for program tradeoffs.

### **Assessing Risk in Tradeoff Analyses**

Risk was often not considered, or was considered improperly, in affordability tradeoff analyses. For example, in some studies risk was assessed for one candidate system but not for another. In other studies, only one type of risk (e.g., schedule risk) was considered, while other types (e.g., cost, technical maturity, interoperability, and statutory/regulatory) were ignored.

Our recommendation is to consider what we call the execution risk framework (Henry, 2011). This method evaluates each alternative across a number of risk sources or categories. For each alternative, the risk for each category is assessed using a utility-like scale. Once an assessment is made for each category, these scores can be combined using a variety of methods, including the max-average (Lamar, 2009) or exponential average (Schmidt, 2015). Risk scores can then be used to calculate risk-adjusted benefit. In addition, understanding where there is risk for a given alternative guides the formulation of new risk-reduction alternatives, which include risk mitigation activities and costs for those activities.

### **Next Steps**

The next step in this research (part 2) will be to construct a guidebook on recommended practices and a software tool to help program offices make analytically-driven tradeoff decisions. This research will result in a simple-to-use tool enabling programs to conduct affordability tradeoff analyses on a regular basis. Although this study focused on DoD program offices, our intent is that all federal agencies will gain from the findings of this research and the products that will become available.

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